Design thinking

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Design thinking refers to creative strategies designers utilize during the process of designing.[1] Design thinking is also an approach that can be used to consider issues and resolve problems more broadly than within professional design practice, and has been applied in business and to social issues.[2] Design thinking in business uses the designer's sensibility and methods to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity.[3]

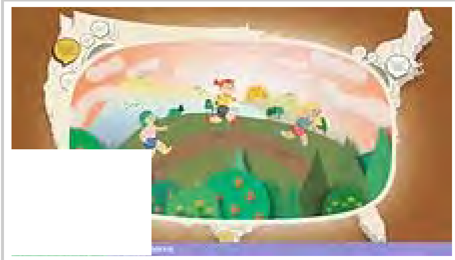
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Origins of the term

The notion of design as a "way of thinking" in the sciences can be traced to Herbert A. Simon's 1969 book *The*

Sciences of the Artificial,[4] and in design engineering to Robert McKim's 1973 book *Experiences in Visual Thinking*.[5] Bryan Lawson's 1980 book *How Designers Think*, primarily addressing design in architecture, began a process of generalising the concept of design thinking.[6] A 1982 article by Nigel Cross established some of the intrinsic qualities and abilities of design thinking that made it relevant in general education and thus for wider audiences.[7] Peter Rowe's 1987 book *Design Thinking*, which described methods and approaches used by architects and urban planners, was a significant early usage of the term in the design research literature.[8] Rolf Faste expanded on McKim's work at Stanford University in the 1980s and 1990s,[9][10] teaching "design thinking as a method of creative action."[11] Design thinking was adapted for business purposes by Faste's Stanford colleague David M. Kelley, who founded the design consultancy IDEO in 1991.[12] Richard Buchanan's 1992 article "Wicked Problems in Design Thinking" expressed a broader view of design thinking as addressing intractable human concerns through design.[13]

Solution-based thinking


Design thinking example video

Design thinking is a method for practical, creative resolution of problems and creation of solutions. It is a form of solution-based, or solution-focused thinking with the intent of producing a constructive future result. By considering both present and future conditions and parameters of the problem, several alternative solutions may be explored.

This approach differs from the analytical scientific method, which begins by thoroughly defining all parameters of a problem with an aim to create a single, correct solution. Design thinking identifies and investigates with known and ambiguous aspects of the current situation to discover hidden parameters and open alternative paths that may lead to the goal. Because design thinking is iterative, intermediate "solutions" are also potential starting points of alternative paths, including redefining of the initial problem, in a process of co-evolution of problem and solution.[14]

Designers vs. Scientists

In 1979 Bryan Lawson published results from an empirical study to investigate the difference problem-solving approaches of designers and scientists. He took two groups of students – final year students in architecture and post-graduate science students – and asked them to create one-layer structures from a set of coloured blocks. The perimeter of the structure had to optimize either the red or the blue colour; however, there were unspecified rules governing the placement and relationship of some of the blocks. Lawson found that:

> The scientists adopted a technique of trying out a series of designs which used as many different blocks and combinations of blocks as possible as quickly as possible. Thus they tried to maximise the information available to them about the allowed combinations. If they could discover the rule governing which combinations of blocks were allowed they could then search for an arrangement which would optimise the required colour around the layout. *[problem-focused]* By contrast, the architects selected their blocks in order to achieve the appropriately coloured perimeter. If this proved not to be an acceptable combination, then the next most favourably coloured block combination would be substituted and so on until an acceptable solution was discovered. *[solution-focused]*
>
> — *Bryan Lawson, How Designers Think*[6]

Nigel Cross concluded that Lawson's studies suggested that scientists problem solve by analysis, while designers problem solve by synthesis.[7] Kelley and Brown argue that design thinking uses both analysis and synthesis.

Analysis and synthesis

The terms analysis and synthesis come from (classical) Greek and mean literally "to loosen up" and "to put together" respectively. In general, analysis is defined as the procedure by which we break down an intellectual or substantial whole into parts or components. Synthesis is defined as the opposite procedure: to combine separate elements or components in order to form a coherent whole. However, analysis and synthesis, as scientific methods, always go hand in hand; they complement one another. Every synthesis is built upon the results of a preceding analysis, and every analysis requires a subsequent synthesis in order to verify and correct its results.[15]

Divergent thinking versus convergent thinking

Design thinking employs divergent thinking as a way to ensure that many possible solutions are explored in the first instance, and then convergent thinking as a way to narrow these down to a final solution. Divergent thinking is the ability to offer different, unique or variant ideas adherent to one theme while convergent thinking is the ability to find the "correct" solution to the given problem. Design thinking encourages divergent thinking to ideate many solutions (possible or impossible) and then uses convergent thinking to prefer and realize the best resolution.

Design thinking as a process for problem-solving

Unlike analytical thinking, design thinking includes "building up" ideas, with few, or no, limits on breadth during a "brainstorming" phase.[16] This helps reduce fear of failure in the participant(s) and encourages input and participation from a wide variety of sources in the ideation phases. The phrase "thinking outside the box" has been coined to describe one goal of the brainstorming phase and is encouraged, since this can aid in the discovery of hidden elements and ambiguities in the situation and discovering potentially faulty assumptions.

One version of the design thinking process has seven stages: *define*, *research, ideate, prototype, choose, implement*, and *learn*.[4] Within these seven steps, problems can be framed, the right questions can be asked, more ideas can be created, and the best answers can be chosen. The steps aren't linear; can occur simultaneously and be repeated. A simpler expression of the process is Robert McKim's phrase "Express–Test–Cycle".[5] An alternative five-phase description of the process is described by Christoph Meinel and Larry Leifer: *(re)defining the problem, needfinding and benchmarking, ideating, building, testing*.[17] Yet another way to look at it is Shewhart's "Plan-Do-Study-Act" PDSA cycle.

Although design is always influenced by individual preferences, the design thinking method shares a common set of traits, mainly: creativity, ambidextrous thinking, teamwork, user-centeredness (empathy), curiosity and optimism.[10] These traits are exemplified by design thinking methods in "serious play".

The path through these process steps is not strictly circular. Meinel and Leifer state: "While the stages are simple enough, the adaptive expertise required to choose the right inflection points and appropriate next stage is a high order intellectual activity that requires practice and is learnable."[17]

Attributes of design thinking

Principles

Christoph Meinel and Larry Leifer, of the HPI-Stanford Design Thinking Program, laid out four principles for the successful implementation of design thinking:[17]

The human rule – all design activity is ultimately social in nature

The ambiguity rule – design thinkers must preserve ambiguity

The re-design rule – all design is re-design

The tangibility rule – making ideas tangible always facilitates communication

Wicked problems

Design thinking is especially useful when addressing what Horst Rittel referred to as *wicked problems*, which are ill-defined or tricky (as opposed to wicked in the sense of malicious).[18] With ill-defined problems, both the problem and the solution are unknown at the outset of the problem-solving exercise. This is as opposed to "tame" or "well-defined" problems where the problem is clear, and the solution is available through some technical knowledge.[19]

For wicked problems, the general thrust of the problem may be clear, however considerable time and effort is spent in order to clarify the requirements. A large part of the problem solving activity, then, consists of problem definition and problem shaping.[20]

The "a-ha moment"

The "a-ha moment" is the moment where there is suddenly a clear forward path.[21] It is the point in the cycle where synthesis and divergent thinking, analysis and convergent thinking, and the nature of the problem all come together and an appropriate resolution has been captured. Prior to this point, the process may seem nebulous, hazy and inexact. At this point, the path forward is so obvious that in retrospect it seems odd that it took so long to recognize it. After this point, the focus becomes more and more clear as the final product is constructed.[22]

Methods and process

Design methods and *design process* are often used interchangeably, but there are significant differences between the two.

Design methods are techniques, rules, or ways of doing things that someone uses within a design discipline. Methods for design thinking include interviewing, creating user profiles, looking at other existing solutions, creating prototypes, mind mapping, asking questions like the five whys, and situational analysis.

Because of design thinking's parallel nature, there are many different paths through the phases. This is part of the reason design thinking may seem to be "fuzzy" or "ambiguous" when compared to more analytical, Cartesian methods of science and engineering.

Some early design processes stemmed from soft systems methodology in the 1960s. Koberg and Bagnall wrote *The All New Universal Traveller* in 1972 and presented a circular, seven-step process to problem-solving. These seven steps could be done lineally or in feed-back loops.[23] Stanford's d.school developed an updated seven step process in 2007.[24] Other expressions of design processes have been proposed, including a three-step simplified triangular process (or the six-part, less simplified pyramid) by Bryan Lawson.[6] Hugh Dubberly's free e-book *How Do You Design: A Compendium of Models* summarizes a large number of design process models.[25]

Design thinking calls for considering the given user case from various perspectives, empathizing with users, and addressing various stakeholders.

The use of visual analogy in design thinking and learning

Ill-defined problems often contain higher-order and obscure relationships. Design thinking can address these through the use of analogies. An understanding of the expected results, or lack of domain-related knowledge for the task, may be developed by correlating different internal representations, such as images, to develop an understanding of the obscure or ill-defined elements of the situation. The process involves several complex cognitive mechanisms, as the design task often has elements in multiple cognitive domains—visual, mathematical, auditory or tactile—requiring the usage of multiple "languages", like visual thinking.

Design thinking for social innovation

Social challenges require systemic solutions that are grounded in the client’s or customer’s needs. Nonprofits are beginning to use design thinking as well to develop better solutions to social problems, because it crosses the traditional boundaries between public, for-profit, and nonprofit sectors. By working closely with the clients and consumers, design thinking allows high-impact solutions to bubble up from below rather than being imposed from the top.[26]

The process of design thinking

Inspiration, ideation and implementation

As an approach, design thinking taps into innate human capacities but that are overlooked by more conventional problem-solving practices. It does not only focus on creating products and services that are human centered, but the process itself is also deeply human.[26] The process is best thought of as a system of overlapping spaces rather than a sequence of orderly steps: inspiration, ideation, and implementation.[27] Inspiration is the initial problem or opportunity that leads you to the finding of the solution; ideation is the core of the development process where the idea is better defined; and implementation is the final step where the solution comes in contact with the outer world. Projects may loop back through inspiration, ideation, and implementation more than once as the team refines its ideas and explores new directions. Therefore, design thinking can feel chaotic, but over the life of a project, participants come to see that the process makes sense and achieves results, even though its form differs from the linear, milestone-based processes that organizations typically undertake.[28] Design thinking activities are carried on in different steps which are: empathize, define, ideate, prototype and test.[29] Within these steps, problems can be framed, the right questions can be asked, more ideas can be created, and the best answers can be chosen.

Inspiration space and empathy stage

Generally, the design process starts with the inspiration phase, in which the previous step is the definition of the brief. The brief is a set of mental constraints that gives the project team a framework from which to begin, benchmarks by which they can measure progress, and a set of objectives to be realized—such as price point, available technology, and market segment.[28] Designer approach to users with empathy, understanding what human need or might need, what makes life easier and more enjoyable, what is technology useful and more usable. It is not only about making things more ergonomic but about understanding people - the way they do things and why, their physical and emotional needs, how they think about the world, and what is meaningful to them.[30] Conventional research methods, like focus groups and survey, can be useful in pointing towards incremental improvements, but those don't usually lead to breakthroughs because these techniques simply ask people what they want. Henry Ford understood this when he said, "If I'd asked my customers what they wanted, they'd have said 'a faster horse." and no one would have said a car.[28]

Ideation: Divergent thinking versus convergent thinking

Ideate is the mode of the design process in which you concentrate on idea generation. Mentally it represents a process of "going wide" in terms of concepts and outcomes.[31] The process is characterized by the alternation of divergent and convergent thinking, typical of design thinking process. To achieve divergent thinking, it is important to have a diverse group of people involved in the process. Multidisciplinary people—architects who have studied psychology, artists with MBAs, or engineers with marketing experience—often demonstrate this quality. They're people with the capacity and the disposition for collaboration across disciplines.[28]

Interdisciplinary teams typically move into a structured brainstorming process by "thinking outside the box". During this process own ideas and the other's one have not to be judged and participants shouldn't take a non-generative role.[32] Instead, participants are encouraged to come up with as many ideas as possible and to explore new alternatives. Good ideas naturally rise to the top, whereas the bad ones drop off early on. Every member of the team needs to possess a depth of skill that allows him or her to make tangible contributions to the outcome, and to be empathic for people and for disciplines beyond one's own. It tends to be expressed as openness, curiosity, optimism, a tendency toward learning through doing, and experimentation.[26] Convergent thinking, on the other hand, allow to zooming and focusing on the different proposals and to select the best choice, which permits to continue the design thinking process to achieve the final goals. After collecting lot of ideas, a team goes through a process of synthesis in which it has to translate what is been seen and is been headed into insights that can lead to solutions or opportunities for change. This approach helps multiply options to create choices and different insights about human behavior and define in which direction the process should go on. These might be either visions of new product offerings, or choices among various ways of creating interactive experience.[28] Once there are lot of ideas, the following step is to select the most extreme one in order to find solutions that solve unmet needs.

Complexity and mindset conditions

More choices mean more complexity, which can affect organization's decisions to restrict choices in favour of the obvious and the incremental. Although this tendency may be more efficient in the short run, it tends to make an organization conservative and inflexible in the long run.[26] Divergent thinking is the route, not the obstacle, to innovation, and a way to diverge is to define a mindset of condition in which people are encouraged to produce lots of ideas. The most notable themes fall into three general traits: open-minded collaboration, courage, and conviction.[33] Open minded refers to the concept of being opened and accept new ideas and contributions. Courage is also fundamental because innovative ideas are characterized by a high risk of failure. It permits to face failure, element of high importance in order to improve in the right way. In addition, conviction is the mindset which permits to carry on a process or an idea even if there are constrains or

obstacles.

Implementation and prototyping

The third space of the design thinking process is implementation, when the best ideas generated during ideation are turned into a concrete, fully conceived action plan.[26] At the core of the implementation process is prototyping: turning ideas into actual products and services that are then tested, iterated, and refined. A prototype helps to gather feedbacks and improve the idea. Prototypes speed up the process of innovation because allow to understand strengths and weaknesses of new solutions. Prototyping is particularly important for products and services destined for the developing world, where the lack of infrastructure, retail chains, communication networks, literacy, and other essential pieces of the system often make it difficult to design new products and services.[26] Prototyping, testing, “failing many times but quickly and cheaply in order to succeed” [34] are different existing methods to test solutions, but the earlier users can give feedbacks, the lower are the costs for the organizations and higher is the level of adaptation of the solution to customer needs.

Differences from science and humanities

Although many design fields have been categorized as lying between science and the arts and humanities, design may be seen as its own distinct way of understanding the world, based on solution-based problem solving, problem shaping, synthesis, and appropriateness in the built environment.

One of the first design science theorists, John Chris Jones, postulated that design was different than the arts, sciences and mathematics in the 1970s. In response to the question "Is designing an art, a science or a form of mathematics?" Jones responded:

> The main point of difference is that of *timing*. Both artists and scientists operate on the physical world as it exists in the *present* (whether it is real or symbolic), while mathematicians operate on abstract relationships that are independent of historical *time*. Designers, on the other hand, are forever bound to treat as real that which exists only in an imagined *future* and have to specify ways in which the *foreseen* thing can be made to exist.
>
> — *John Chris Jones, Design Method*[35]

Nigel Cross built upon the early work of Bruce Archer to show the differences between the humanities, the sciences, and design in his paper "Designerly Ways of Knowing". He observed that:[7]

The phenomenon of study in each culture is

- in the sciences: the natural world
- in the humanities: human experience
- in design: the artificial world

The appropriate methods in each culture are

- in the sciences: controlled experiment, classification, analysis
- in the humanities: analogy, metaphor, evaluation
- in design: modeling, pattern-forming, synthesis

The values of each culture are

- in the sciences: objectivity, rationality, neutrality, and a concern for "truth"

- in the humanities: subjectivity, imagination, commitment, and a concern for "justice"
- in design: practicality, ingenuity, empathy , and a concern for "appropriateness"

The languages of design

Conventionally, designers communicate mostly in visual or object languages.[7][36] Symbols, signs, and metaphors are used through the medium of sketching, diagrams and technical drawings to translate abstract requirements into concrete objects. The way designers communicate, then, is through understanding this way of coding design requirements in order to produce built products.[37]

Design thinking in business

Design thinking has two common interpretations in the business world:

1. Designers bringing their methods into business by either taking part themselves in business process, or training business people to use design methods
2. Designers achieving innovative outputs or products (for example, the iPod)

The first interpretation has been described by Tim Brown, CEO of IDEO, at a TED lecture,[38] though his blog[39] also considers the second interpretation.

The limits of the first kind of design thinking in business are also being explored. Not all problems yield to design thinking alone, where it may be a "temporary fix".[40] Design thinking companies including IDEO and Sense Worldwide are responding to this by building business thinking capabilities.[41]

Tim Brown has argued that design thinking is now widely, but sporadically, used in business. He argues that competitive advantage comes from sustained use of design thinking, from becoming "masters of the art."[42]

In organization and management theory, design thinking forms part of the Architecture/Design/Anthropology (A/D/A) paradigm, which characterizes innovative, human-centered enterprises. This paradigm also focuses on a collaborative and iterative style of work and an abductive mode of thinking, compared to practices associated with the more traditional Mathematics/Economics/Psychology (M/E/P) management paradigm.[43]

A study by the London Business School found that for every percent of sales invested in product design, profits rose by an average of 3 to 4 percent.[44]

Historically designers were only introduced in the last steps of product development process, focusing their attention on improving the look and functionality of products, instead looking for a high impact on the world and the society. Design was a tool of consumerism, able to make products more attractive, easier to use and more marketable.[45] In recent years designers developed specific methods and tools to deliver products and services and businesses are beginning to realize the necessity of design as a competitive asset. Therefore designers bring their methods into business by either taking part themselves in the earliest stages of business processes or training business people to use design methods and to build business thinking capabilities. Design thinking, as the perfect balance between desirability, technical feasibility and economic viability helps organizations to be more innovative, better differentiate their brands, and bring their products and services to market faster.[45]

Design thinking in education

Design thinking has been suggested for use in schools in a variety of curricular ways,[46][47][48] as well as for redesigning student spaces and school systems.[49]

Design thinking in education typically takes three forms: helping school administrators solve institution-based problems, aiding educators develop more creative lesson plans, and engendering design thinking skills in students.

There are currently many researchers exploring the intersection of design thinking and education.[50] The REDLab group, from Stanford University's Graduate School of Education, conducts research into design thinking in K-12, secondary, and post-secondary settings.[51] The Hasso Plattner Design Thinking Research Program is a collaborative program between Stanford University and the Hasso Plattner Institute from Potsdam, Germany.[50][52] The Hasso Plattner Design Thinking Research Program's mission is to "apply rigorous academic methods to understand how and why design thinking innovation works and fails."[52]

SPJIMR, a top B-school in India, offers a road map to build design thinking culture in the organisation and has implemented the approach across its different management programs.

In addition to enriching curriculum and expanding student perspectives, design thinking can also benefit educators. Researchers have proposed that design thinking can enable educators to integrate technology into the classroom.[53]

Design thinking as a viable curricular and systemic reform program is increasingly being recognized by educators. "Much of today's education system guides students toward finding the correct answers to fill-in-the blanks on standardized tests, as this kind of instruction facilitates streamlined assessments to measure success or failure ... It is critical that, particularly in under-served schools this model of learning does not continue to prevail. Students need both the skills and the tools to participate in a society where problems are increasingly complex and nuanced understandings are vital."[54]

Uses in K-12 education

In the K-12 arena, design thinking is used to promote creative thinking, teamwork, and student responsibility for learning. The nonprofit Tools at Schools aims to expose students, educators, and schools to design thinking. The organization does this by facilitating a relationship between a school and a manufacturing company. Over a minimum of six months, representatives from the manufacturing company teach students the principles of design and establish the kind of product to be designed.[55] The students collaborate to design a prototype that the manufacturer produces.[55] Once the prototype arrives, the students must promote the product and support the ideas that lead to its design.[55]

An example of the Tools at Schools partnership is the redesign of school equipment by 8th grade students at The School at Columbia University. The students were divided into groups and asked to redesign a locker, chair, or a desk to better suit the needs of 21st century pupils.[56] The students' final products were displayed at the International Contemporary Furniture Fair where they demonstrated their product to fair attendees and industry professionals.[56] Overall Tools at Schools not only introduces students to the design process, it exposes them to the design profession through their interactions with designers and manufacturers.[56] Since the students work together in groups, design thinking in education also encourages collaborative learning.

Another organization that works with integrating design thinking for students is the corporation NoTosh. NoTosh has a design thinking school to teach instructors how to implement design thinking into their curriculum. One of the design thinking techniques NoTosh adopted from the corporate world and applied to

education is hexagonal thinking. Hexagonal thinking consists of gathering cut-outs in hexagon shapes and writing a concept or fact on each one. Students then connect the hexagons by laying related ideas or facts together. The visual representation of relationships helps students better conceptualize wicked problems.[57] Another concrete example of design thinking in action is NoTosh's "Googleable vs NonGoogleable Questions" exercise.[57] Given a specific topic, students brainstorm questions on that issue and divide their questions into "Googleable and NonGoogleable."[57] Students research the Googleable questions and present their findings to the class while the NonGoogleable questions are used to create a project.[57]

Stanford University's Taking Design Thinking to Schools Initiative

Apart from non profit entities and corporations, research universities are also involved in deploying design thinking curriculum to K-12 schools. Part of Stanford University's efforts to incorporate design thinking in education into a hands-on setting is the Taking Design Thinking to Schools initiative. The Stanford School of Education and d.school partner with K-12 teachers in the Palo Alto area to discover ways to apply design thinking in an educational setting.[58] "Teachers and students engage in hands-on design challenges that focus on developing empathy, promoting a bias towards action, encouraging ideation, developing metacognitive awareness and fostering active problem solving."[58]

Taking Design Thinking to Schools identifies the following design thinking process:

- *Understand*: students explore the topic through research and develop familiarity with the subject matter
- *Observe*: this phase consists of students taking note of their environment, which includes physical surroundings and human interactions; students gather more information about peoples' actions and possible motivation through discussion
- *Point of view*: students consider alternate points of views to better understand the problem and to inform their ideas in the next phase
- *Ideate*: this phase consists of students brainstorming ideas without criticism or inhibition. In this phase, the focus is on generating lots of ideas with an emphasis on creativity and enjoying the process.
- *Prototype*: in this phase students create quick prototypes to investigate ideas generated during the ideation phase
- *Test*: students test their ideas in a repetitive fashion and determine which aspects of the design are effective and which could be improved.[58]

By employing this process, the Stanford team and Taking Design Thinking to Schools participants collaborate to develop coursework that students will find engrossing and "hands-on."[58] Thus, the program at Stanford combines both design thinking for teachers who must create alternative curriculum and students who must complete the design thinking-based projects.

The K12 Lab at Stanford

The K12 Lab network is a part of the Stanford University d.school and according to its website its mission is to "inspire and develop the creative confidence of educators and support edu innovators catalyzing new models for teaching and learning."[59] The K12 Lab Network publishes a wiki with information on creating design challenges for K-12 schools. The wiki provides tools for thinking about design challenges as well as criteria for implementing design challenges.[60]

The Design Thinking for Educators toolkit

The Design Thinking for Educators toolkit was developed in 2011 by the design firm IDEO in partnership with

the PreK-12 independent school Riverdale Country School.[61] The Design Thinking for Educators toolkit that is currently offered to the public for free download is the second version.[62] The Design Thinking for Educators toolkit is a comprehensive resource for educators to use, which includes a "walk-through of the design thinking process complete with examples and a downloadable workbook".[63] The toolkit has been used in academic research to aid in the creation of an "iPad learning Ecosystem".[64] to help design a program to aid at-risk youth in the transition from elementary to secondary school,[64] as well as to redesign libraries.[63]

AIGA

AIGA has implemented a movement, DesignEd K12, to take designing thinking to schools. This movement is guided by volunteers and there is not a specific program to follow; instead volunteer designers introduce students to the design field and consequently, design thinking. DesignEd K12 intends to motivate students to use design thinking to solve problems; to create a network where designers, students, and educational professionals share best practices; to shape a recommended approach to teaching design; and to cultivate a passion for design among young people.[65] Across the nation, many of AIGA's chapters are working with school districts. The programs range in scope; some mentor students who have shown an interest in design, while other programs offer students the opportunity to explore design and participate in design thinking projects within scheduled classed or through an after-school activity.[65]

Uses in higher education

Design thinking is currently being taught in "workshops, supplemental training, courses, or degree programs" in over 60 universities and colleges.[66] Design thinking is used by colleges as a way to instruct students on the phases of design, and to help develop innovative solutions to existing problems.[66] The d.school at Stanford University is a well-known design thinking program in higher education, with students from Stanford's departments of engineering, medicine, business, law, and education utilizing the d.school to develop innovative solutions to problems.[67] The University of Kentucky also has formalized instruction on design thinking through its dLab. The dLab serves a multitude of functions from helping schools resolve their issues with design thinking to conducting empirical experiments on design thinking to collaborating with outside organizations to provide issues that plague their organization.[68] Radford University, located in Radford, Virginia, currently offers a Master of Fine Arts (MFA) degree in design thinking.[57] The MFA degree offered is a completely online degree that emphasizes design thinking, design history, design research, design management, and design doing.[69]

The Johns Hopkins University Carey Business School and the Maryland Institute College of Art began offering an MBA/MA in design leadership in 2012.[70] Students simultaneously earn a master of arts degree in design leadership from an art school as well as an MBA from a research institution.

Obstacles to implementing design thinking in schools

The accountability to succeed on high-stakes standardized tests in K-12 environments prevents the implementation of design thinking curriculum. Educators feel that focusing on classic curriculum will better prepare their students to perform well on these exams.[54] Resistance to design thinking also springs from concerns about the appropriateness of applying design thinking to an educational setting. It has been argued that design thinking is best applied by professionals who know a field well.[71] Therefore, K-12 students who are limited by their reduced understanding of both the field and their still developing intellectual capacities may not be best suited to design thinking activities.[71]

Another more subtle obstacle to design thinking in schools may come from members of the academic community who believe design thinking should remain in the milieu of avant-garde companies.[72] Other issues that may prevent the implementation of design thinking in scholastic settings may be a lack of awareness of the field, educators' uncertainty in implementing new approaches to teaching, and lack of institutional support.

Even for institutions that see the value of design thinking, there is the issue of implementing these new approaches to education successfully. Admittedly "creating an effective thinking and successful team learning experience is a sticky wicked problem."[66]

Design thinking in teaching and learning through ICT

The integration of ICT into teaching and learning presents many challenges that go beyond issues dealing with technical implementation. Some researchers have already claimed the limited effects of ICT adoption in learning;[73][74][75] Considering the emphasis and the investment that has been placed on the use of ICT in formal learning settings (schools and higher education institutions) it is important to identify where the problems are. In this regard, some voices of the educational community focus on the methods used for integrating ICT in teaching and learning;.[76][77] In this sense, the adoption of a design thinking mindset is regarded as a promising strategy to develop holistic solutions.

Design thinking in teaching and learning through ICT can be considered as similar activities. First, it's important to acknowledge that the type of problems faced by the educational community when adopting learning technology are unique, ill-defined and do not have clear solutions;.[78][79] This definition corresponds very well to the term *wicked problems* used by the design community.[80] Secondly, similarly to what happens in design, the diversity of actors brings another layer of complexity that should be recognized. In this regard, collaboration between different stakeholders during the design process is another key issue that could contribute to develop more meaningful technologies for learning;[76][77][81]

Design thinking has been outlined as a meaningful approach for facing wicked problems.[13] The adoption of a design mindset helps understand that there can be many solutions for a given situation and that any design requires testing. From this perspective, bringing design thinking to learning design and design expertise to the development process of technological learning solutions can contribute to the creation of more holistic solutions in learning through ICT.[82]

History

pre-1960	The origins of new design methods in the 1960s lay further back in the application of novel "scientific" methods to the pressing problems of World War II from which came operational research methods and management decision-making techniques, and in the development of creativity techniques in the 1950s. Harold van Doren published *Industrial Design – A Practical Guide to Product Design and Development*, which includes discussions of design methods and practices, in 1940.
1960s	The beginnings of computer programs for problem solving, the so-called soft-systems approach. The 1960s marked a desire to "scientize" design through use of the computer science soft-systems approach.[83]
1962	The First Conference on Design Methods, London, UK. Books on methods and theories of design in different fields are published by Morris Asimow (1962) (engineering),[84] Christopher Alexander (1964) (design patterns),[85] L. Bruce Archer (1965) (industrial design),[86] and John Chris Jones (1970) (architecture).[87] The first notable books on methods of creativity are published by William J. J. Gordon (1961)[88] and Alex Faickney Osborn (1963).[89]
1965	L. Bruce Archer, professor of Design Research at the Royal College of Art argues that design was "not merely a craft-based skill but should be considered a knowledge-based discipline in its own right, with rigorous methodology and research principles incorporated into the design process" and states: "The most fundamental challenge to conventional ideas on design has been the growing advocacy of systematic methods of problem solving, borrowed from computer techniques and management theory, for the assessment of design problems and the development of design solutions."[86][90] Bruce Archer is arguably the first author to use the term design thinking in his book "Systematic Method for Designers" London: Council of Industrial Design, H.M.S.O.
1969	Herbert A. Simon notable for his research in artificial intelligence and cognitive sciences establishes a "science of design" that would be "a body of intellectually tough, analytic, partly formalizable, partly empirical, teachable doctrine about the design process."[4] Visual psychologist Rudolf Arnheim publishes his book *Visual Thinking*, which inspires the teaching of ME101: Visual Thinking, by Robert McKim, in the School of Engineering at Stanford University.[5]
1970s	Notable for the rejection of design methodology by many, including some of the early pioneers. Christopher Alexander, architect and theorist, wrote: "I've disassociated myself from the field. There is so little in what is called 'design methods' that has anything useful to say about how to design buildings that I never even read the literature anymore. I would say forget it, forget the whole thing."[91] John Chris Jones, designer and design thinking theorist, stated: "In the 1970s I reacted against design methods. I dislike the machine language, the behaviourism, the continual attempt to fix the whole of life into a logical framework."[92]

See also

- Creativity techniques
- Design-based learning
- Design management
- Design engineer
- Design methods
- Design patterns
- Design strategy
- Design tool
- Enterprise architecture
- Lateral thinking
- Metadesign
- Participatory design
- Problem solving
- Reflective practice
- Scenario thinking
- Service design
- Strategic design
- Sustainable design
- Systems thinking
- Transgenerational design
- Universal design
- User experience
- User-centered design
- Wicked problem

Portals

- Portal:thinking
- Portal:design

Lists

- List of thought processes
- List of creative thought processes

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